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General Education and Secondary School Biology

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In recent months the General Education emphasis has come to have increased importance in educational considerations. It is an emphasis that must necessarily be of interest to teachers of secondary school biology. One of the questions commonly asked concerns effects that the program of General Education may have upon the teaching of biology. It is our present purpose to consider some of the possibilities. Let us begin by defining two terms.

We shall assume that "secondary school biology" consists of the biological facts and concepts commonly included among instructional materials of grades seven to twelve. Such materials may appear in a number of different courses, but tend to be concentrated in those designated as "biology," "general biology, "general science," and "advanced biology." Some might question the inclusion of general science in this group, holding that the biological content of *some* courses, as taught by *some* teachers, is not sufficiently representative. They sometimes indicate that such courses have become creatures of the physical scientists. Be that as it may, it is evident that general science has prospered to the extent that it can no longer be ignored by biologists. If *some* general science courses are unsatisfactory to the biologists, it may be because the latter have at times adopted an attitude of critical opposition, and have absented themselves from the council tables.

The second term we shall wish to identify is "General Education." It is not easy to define, even upon an arbitrary basis. Perhaps we can best approach the matter by considering some of the forces and events which seem in part responsible for modern educational trends. There has been considerable unrest ever since the turn of the century. Aims, objectives, courses-of-study, curriculums, and teaching methods have presented a rapidly-shifting scene at times. Various educational trends have developed, each to hold

the stage for a few brief months or years, then to be superseded by something different. Dozens of catch words or phrases have been coined or re-defined, to bewilder the teacher with a language that is often obscure, and sometimes suspect of being largely meaningless.

The writer does not feel that this has merely been an expression of desire to do something new or different at any cost. Far more fundamental concerns and forces have been at work. Chief among these has been the rapidly-changing character of the secondary school population. In 1900, the high school had a highly-selected pupil group. Since that time, however, the selective action of the lower school has diminished, thus giving rise to a modern high school population that is markedly heterogeneous in many cases. Teachers and administrators often complain that the "old subjects" are too difficult for pupil-comprehension. Many "new subjects," some said to be rather dilute, have been added to secondary school curriculums.

Moreover, there have been numerous public utterances to the effect that the educative process has not been producing desired results; that pupils often emerge with far too little understanding of the world in which they live. One wonders why the school should be singled-out as the only possible agency at fault, but is shocked and sobered by the apparent effectiveness of directed education in certain totalitarian states.

These are some, but by no means all of the considerations that form a background for the General Education emphasis. Its frank purpose is to provide education for citizenship in a democratic social order. It focuses attention upon the common affairs of everyday life. Its primary concern must necessarily be the common needs and interests of average pupils, but it does not propose to limit its attention to this group.

One interesting feature of General Education work is that much of the pioneering effort has been expended in the area of science education, and that extension into other fields of learning is now in progress. Slightly more than two years ago the General Education Board made a grant to Teachers College, Columbia University, for a General Education project in science, to be carried out under the direction of Professor S. R. Powers. This made possible the Bureau of Educational Research in Science.

The latter organization has concerned itself with two general projects. First, various specialists in subject-matter fields have been assembling research findings that have apparent relationships to everyday affairs. Emphasis has centered upon the more recent discoveries; the materials that often do not get into textbooks until some time has passed. These assemblages of apparently significant facts and concepts are being incorporated in *Source Books*. The Source Books are not textbooks, but are more nearly books of reference It is hoped that they will be used by teachers of science, and by those who prepare course-of-study materials

A second phase of the work has to do with evaluation. Instructional materials have been and are being prepared in the light of the Source Book contents. They are being tried out in school situations, in an effort to determine what outcomes are associated with the learning experiences.

The foregoing description of this Bureau's activities necessarily is brief; it would be impossible to present all perti-

nent details in the space available. A fairly complete account of the work, however, may be found in the January, 1939, issue of the *Teachers College Record.*

Let us now give some thought to ways in which the General Education program may be expected to influence secondary school biology. We may anticipate some standardization of a *General Biology* course, of such difficulty that it is acceptable for the majority of pupils, and whose emphasis is upon the facts and concepts that relate intimately to common experiences. Presumably it will be a beginning course in biology for anyone. It may be expected to feature revitalization and modernization of subject-matter. The latter would clearly be of greater significance in some teaching situations than in others, for secondary school biology is not a uniform commodity; various courses as taught by numerous teachers might today be termed "modern" and "vital," whereas others lag behind frontiers of progress. Extension of the General Education emphasis also gives evidence of fostering a situation in which greater measure of attention will be given to instruction in life science.

In our enthusiasm for mass education, however, we should not forget the pupils who possess more than average ability and are motivated by more than normal interest, for it is from this group that the leaders of tomorrow will undoubtedly come. For them, a year's work in General Biology may only be acceptable as a beginning. It is here suggested that their needs may be met by an advanced biology course on the eleventh or twelfth grade levels. Another possibility is the development of a two-year sequence in biology. In either eventuality it is presupposed that the content materials of the courses would be those of general biology; that the second year courses would not be limited to a few phases of the subject as suggested by some current practices.

The writer has attempted to anticipate possible ill effects that may be concomitants of the General Education emphasis. If one assumes that adequate provision will be made for the needs of gifted pupils this is not easy to do. One warning note may not be amiss, although it is no more appropriate in this case than it would be in any other. All educational fronts acquire a lunatic fringe of self-appointed, often earnest, but likewise unintelligent advocates. Their pronouncements obscure many important issues, and often inhibit worth-while progress. There is another group who, under the protective impetus of a new trend, will attempt to align curriculums or courses-of-study with their own vested or projected interests.

Happily, any such unwanted tendencies have not appeared in General Education circles to date. Perhaps, indeed, we may not be called upon to face such eventualities. If they do materialize, however, we should be quick to recognize them, and to oppose them vigorously. General Education involves many inherent possibilities for progress. It must not be diverted from its appointed course.

BACK COPIES

Due to the rapid growth of our Association during November and December it is possible that a few members have failed to receive one or two copies of the journal. There is available a small supply of the first three numbers of our journal. These will be sent to members who failed to receive their copies, as long as the supply lasts. All requests for back copies should be sent to P. K. Houdek, Secretary-treasurer, Robinson, Illinois.

Light as a Limiting Factor for Aquatic Animals and Plants

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Every school boy knows that light is required for the growth of green plants and that all animals, including ourselves, are dependent directly or indirectly upon the plants for their food supply. It is not so obvious, however, that exactly the same situation is encountered in the aquatic habitat. The ultimate source of energy for all the multifarious life in the sea and in every body of fresh water is sunlight. Furthermore most fish and many types of animals need enough illumination to see—at least part of the time—to catch their food and to avoid being caught themselves. But light does not penetrate into water indefinitely: it is absorbed by the water itself and further reduced by sediment and by stains. The aquatic biologist is thus concerned to know how much light exists at various depths in rivers, ponds, lakes and in the ocean itself, and what are the maximum depths at which fish can see and at which the all-important green plant can make a living.

Since no natural body of water can be any more transparent than pure water itself, let us begin our study of the biological action of light in the aquatic habitat by imagining a lake full of distilled water. The penetration of sunlight into such a lake is represented diagramatically in Figure 1. Depth is indicated along the right hand side of the graph with the surface at the top. At the upper right hand corner of the figure the full (100%) intensity of the sunlight is indicated and

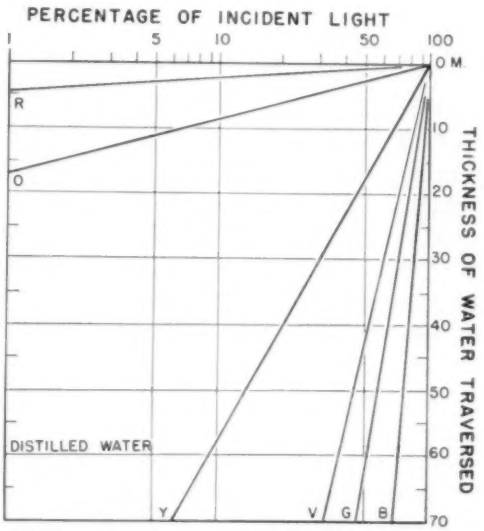

FIGURE 1. Transmission of light by distilled water at six wavelengths within the visible spectrum. Curves show the percentage of incident light (logarithmic scale) which would remain after passing through the indicated thickness of water.

Color	*Wavelength*	*Absorption/meter*
Red	7200 A	64.5%
Orange	6200	23.5
Yellow	5600	3.9
Green	5100	1.1
Blue	4600	0.52
Violet	3900	1.63

diminishing percentages are found toward the left. As we descend into our hypothetical lake the illumination is progressively reduced in intensity, but the *rate* of the diminution is expressed by the slope of the line and this is very different in the various parts of the spectrum. Thus the rate of absorption of the red

(R) element in sunlight is seen to be very high, that for yellow light (Y) lower, and that for blue light (B) very much lower. For example, after traversing 70 meters (about 70 yards) of distilled water blue light has suffered only a slight reduction —to 70% of its initial value, whereas yellow light has been reduced to 6%. In the case of red light a reduction to 6% had already taken place after passing through less than 3 m. of water. There curves represent the uppermost limit possible for the transparency of any body of water.

Now the energy of the sun as it reaches the earth's surface is not equal in all parts of the spectrum but is distributed as shown by the uppermost curve in Figure 2. In this diagram the various colors which make up sunlight are represented along the baseline and the height of the curve is proportional to the intensity of each spectral region. We see that the greatest intensity occurs in the blue-green, that a relatively small amount of energy remains when the ultra-violet is reached, but a considerable amount still exists where the red merges with the infra-red at the extreme right. We therefore start with unequal quantities of energy at the different wavelengths and these are absorbed at unequal rates as the light penetrates into the water. The result is that after passing through successive meters of water the nature of the daylight present becomes rapidly and profoundly altered, as is indicated by the change in the shape of the curves in Figure 2 representing depths down to 100 m. As a consequence after sunlight has traversed 100 m. of distilled water nothing but the blue component of daylight with a little green and violet remains.

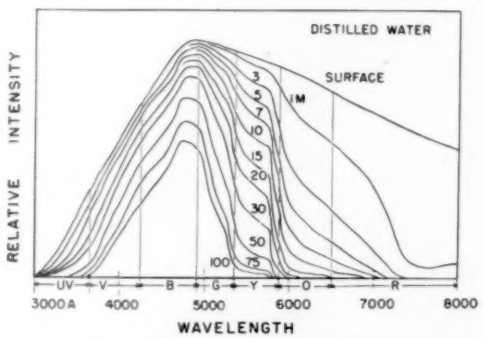

FIGURE 2. The spectral distribution of solar energy at the earth's surface is given by the uppermost curve. When sunlight is passed through successive meters of pure (distilled) water, the reduction of intensity and the change in spectral distribution which result are indicated by the curves beneath. (Courtesy of Dr. E. A. Birge.)

This selective action of the water on sunlight accounts in part for the color which one sees when one looks down into any natural body of water. In the Caribbean or the Sargasso Sea, for example, the water is so very clear that light penetrates to a considerable depth before it is reflected back up to the eye. When the rays emerge, they have been stripped of all parts of the spectrum except the blue. In less transparent water the light does not travel so far before it returns to the surface and hence more of the green and yellow components still remain. In more turbid water suspended particles may themselves appreciably affect the color of the water and in ponds and streams stains are often present which render the water orange or even red.

If we wish to compare the transparencies of different natural waters, it is obvious that we must consider the same part of the spectrum in each case. In Figure 3 the penetration of the central, or yellow-green, region of the spectrum into various typical natural waters is shown. The rates of absorption which these lines represent are taken from actual measurements made in the field by investigation all over the world.

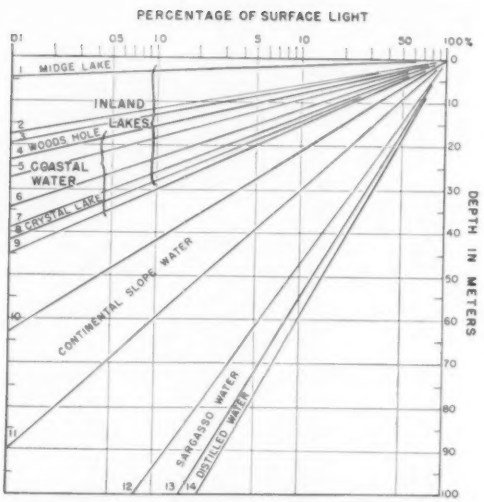

FIGURE 3. Comparison of the rates of penetration of the yellow-green component of daylight into natural waters. Curves show the relation between depth and illumination expressed as a percentage of the light at the surface. (Logarithmic scale.)

Curve	*Location*	*Absorption per meter*
		%
1.	Midge Lake, Wisconsin	78
2.	Trout Lake, Wisconsin	33
3.	Gunflint Lake, Minnesota	30
4.	Woods Hole Harbor	26
5.	Thatcher Pass, San Juan Islands	23
	Buzzards Bay	22
6.	Vineyard Sound	18
7.	Baltic Sea	16
8.	Crystal Lake, Wisconsin	15
9.	English Channel	14
10.	Gulf of Maine (deep basin)	10
11.	Off Vancouver Island	7.6
	Continental Slope, s. of Nantucket Shoals	7.2
12.	Gulf Stream	5.0
13.	Cayman Sea (Caribbean)	4.1
14.	Distilled water	3.8

One observes that the water in the Sargasso Sea is nearly as transparent as distilled water. The illumination, of course, does not come to an abrupt end at any depth: it continues downward indefinitely, but ever diminishing. A convenient way to compare the transparencies of different areas is to state the depths at which the light intensity is reduced to 1% of its value at the surface. Thus in the Sargasso region we see that light can penetrate to 100 meters or more before a reduction to 1% has occurred. Beyond the edge of the Continental Shelf 100 miles or more from the coast in both the Atlantic and the Pacific the transparency is such that the 1% value is reached at about 50 meters. In coastal waters the same value occurs at between 30 m. and 15 m. Although there are a few inland lakes which are as clear as typical coastal waters, the majority of them are more turbid. In Midge Lake, Wisconsin, for example, the illumination has been reduced to 1% of its surface value at 3 m. The extreme range of possible transparency in natural waters is thus very great, and consequently the amount of daylight at any given depth differs tremendously in different cases.

How much light do fish require to see? The fresh-water sunfish has been made to answer this question by a clever experiment which involved moving a series of stripes across the glass side of its aquarium under diminishing illumination. If the sunfish sees a movement of the background, it responds by swimming in the opposite direction. (Its ancestors found this reflex to the apparent movement of the river bottom a useful way to avoid being carried down stream.) When the illumination becomes so weak that the stripes are no longer visible, the sunfish no longer executes its characteristic response. At this point the light intensity was found to be equal to .000,000,000,1 (or 10^{-10}) of full noon sunlight. This is approximately the same as the limit of human vision.

We may now proceed to calculate at what depths such a minimum illumination is to be found. From Figure 3 it

appears that in the Sargasso Sea the light is reduced to 0.1 by each 50 m. of water. Fish are therefore still able to see small objects at a depth of 500 m. (10×50 m.) in this part of the ocean. Although the difference between light and dark may be perceptible for still another 500 m., we can definitely state that below 1000 m. (about half a mile) night is perpetual. On Georges Bank off Cape Cod the maximum depth for vision is about 180 m. But here, since the water is only some 60 m. deep, vision would easily be possible at the bottom. And a similar conclusion is reached in the case of other coastal regions. As for fresh water we find that the limit of vision would occur at 110 meters in the clearest lake where measurements have been made (Crystal Lake, Wisconsin), and 28 m. in a very turbid lake (Adelaid Lake, Wis.), and at 70 m. in a deep lake (Gunflint Lake, Wis.), but in every case the bottom occurs at a lesser depth. Fish can see, then, in every part of the lake, at least during the middle part of the day.

Plants require much more light than the minimum needed for the vision of fish. The result is that plant life is limited to the upper strata of the sea and of deep lakes, whereas animals can range to all depths. In fact, many types of fish, crustacea, and other animals have been captured in nets trawled over the bottom of the ocean at a depth of three miles or more. These animals apparently are able to get along without any illumination—unless, indeed, they make use of each other's luminescence. But even the animals groping about on the floor of the ocean miles beneath the zone of plant life are dependent in the last analysis upon the energy of sunlight stored in the green plant through the process of photosynthesis. Either the plants themselves die and sink down, or are eaten by animals which later descend to the depths and fall prey to the bottom fauna.

The lower limits at which plants are found growing on the bottom will obviously vary very widely according to the transparency. In the Baltic Sea the greatest depth for plant growth is 20 m. and off Iceland it is 50 m., whereas in the Mediterranean the limit may not be reached short of 160 m. In a lake of average transparency such as Trout Lake, Wisconsin, fixed plants are never found deeper than 12 m.

The plants which are rooted in the bottom constitute only a small part of the total vegetation of the ocean or of a lake. A much greater bulk consists of the floating plants such as the blue-green algae and the diatoms which are unicellular and therefore microscopic in size. These exist in every body of water and sometimes are found in very great abundance.

It is relatively easy to determine experimentally the light requirements of these tiny plants, for water containing them can be poured into bottles and suspended by a rope from a buoy at any desired depth in a lake or in the ocean. The rate at which the process of photosynthesis goes on can then be judged by measuring the amount of oxygen which is evolved by the plants within a known interval of time. From a series of such hanging bottle experiments one may ascertain the greatest depth at which any appreciable photosynthesis is taking place. But this is only half the story. Every living plant must respire and this means the consumption of oxygen. The destructive metabolic process represented by respiration is going on at the same time as the up-building process of photo-

synthesis and, in order for the plant to maintain itself and to grow, the latter must go forward at a faster rate than the former. The depth at which the illumination is sufficient to allow photosynthesis just to balance respiration is termed the *compensation point*. Although some photosynthesis may be going on below this level, the plants at greater depths are fighting a losing battle and will eventually die. The lessened intensity of light will not enable the storage of energy to take place as fast as the respiration of the plant requires. The compensation point during the middle of the day in the Sargasso Sea probably occurs at a depth greater than 100 m.; in the English Channel it has been located at 45 m., in Woods Hole Harbor at 7 m., and in Trout Lake at about 12 m.

The plant is under a further disadvantage in that respiration proceeds continuously but photosynthesis can go on only during the daylight hours. Accordingly the plant must manufacture enough food while the sun is up to tide it over the rest of the 24 hours. From the point of view of the continued growth of the plant the really significant value is the depth of the compensation point over the whole 24 hour period. The depth at which photosynthesis is just sufficient on this basis will be much less but the exact level has not yet been measured in any lake. In a Scottish estuary the compensation point was found to vary from 2 m. to 30 m. according to the season. The organic matter built up by the green plants in this very thin stratum at the surface is therefore the entire ultimate source of energy for the whole of the depth of the water beneath it.

Of all the light which falls upon the surface of a lake it has been calculated that only from 1½% to 14% is absorbed by the plants suspended in the water. The efficiency of photosynthesis, *i.e.*, the process of converting the radiant energy absorbed by the plant into the potential energy of the carbohydrate formed—under natural conditions is somewhat less than 3%. When the two factors are taken together we obtain an over-all efficiency of production ranging roughly from .04% to .4%. The efficiency with which aquatic algae manufacture carbohydrate is therefore only a small fraction of a per cent. It thus appears that most of the light incident on the surface of lakes or oceanic areas is absorbed by the water itself or by sediment and stains, and that only a very small part of it can be utilized by plants or animals. We conclude that aquatic organisms are existing under very unfavorable circumstances in regard to the utilization of solar energy. It is for this reason that light is so frequently found to be a limiting or a highly significant factor in the aquatic environment.

PROGRAM SUGGESTIONS

To aid in the construction of interesting and valuable programs for local Biology Teachers Associations, the National Secretary is preparing a booklet of programs that have been held in various local associations.

At present the booklet contains the programs of the last ten annual meetings of the Illinois Biology Teachers Association and a few other suggestions. Any member of our association who is preparing programs for local meetings may borrow this booklet for a limited time. Send requests to Mr. P. K. Houdek, Secretary-Treasurer, Robinson, Illinois.

Pedagogia

Abstracts from the Literature

T. F. Morrison

POWERS, S. R. *Improvement of Science Teaching.* Teachers' College Record, 40: 273–283; Jan., 1939.

Dr. Powers introduces this special number of The Record with a general article on the relation of science instruction to the modern school and scholar. By specific references to subsequent articles which deal with the various fields of Science, he shows how the subject can be of vital importance in this present changing civilization.

FITZPATRICK, F. L. *Implications of Our Knowledge Concerning Biological Production and Control.* Teachers College Record, 40: 297–307; Jan., 1939.

Education cannot cause an entire nation to become suddenly conscious of its duties to posterity in the matter of the control of biological processes and the development of increased productivity. "But," continues the author, "the specific information of science which relates it to such conduct can be organized and related to a number of concepts and general insights . . . which may be the guiding forces in determining their behavior. Here lies the task of education. . . ."

SEARS, P. G. *Life Science in the New General Education.* Teachers' College Record, 40: 340–352; Jan., 1939.

Professor Sears, the author of that very interesting book, "Deserts on the March," draws an analogy between the relation of man to his environment and the tight-wire bicycle rider: both must maintain a "moving balance." How man can do this depends to a large extent on how well he has been taught to control both the animate and inanimate factors in his environment. Science education plays its rôle in explaining this relationship.

MANN, P. B. *Attitudes and Their Relation to Science Education.* Secondary Education, 8: 17–20; Jan., 1939.

If properly handled, scientific experiments can more than carry their share of the burden of teaching the scientific method. To attain this objective is not easy and the routine conduct of the classwork may produce the opposite effects unless care is used. Mr. Mann offers the following suggestions based on his experience with high school classes:

1. Give only the minimum of directions. Let the student solve his own problems.

2. Have pupil assistants whenever possible; it arouses the interest and stimulates the ambitions of their classmates.

3. Give no clues to the answers. A well-planned and well-executed experiment or demonstration will do this.

4. Mechanical copying of figures and materials from texts, or dictations, into notebooks is of very dubious value.

5. Outside reading broadens horizons.

6. Drawings should be neat and truthful.

7. Tests should involve problem solving.

8. Each class session should be a cooperative venture in which class and teacher take part.

9. Remember the socio-economic aspects of the subject.

Sex Education with the Aid of Parents

P. K. HOUDEK
Township High School, Robinson, Illinois

The general plan of presenting sex education as a part of a biology course is in no way new. The simplicity of the plan used in the Robinson Township High School is so safe from criticism by even the most conservative citizens that teachers may be willing to use it in other schools.

The plan presented below has been in use in the author's high school for seven years. Convinced that a well-rounded biology course could be the basis for a program of social hygiene education and recognizing the dangers of a poorly organized attempt, the author made a cautious start in 1932.

The first step was self education. For several months the author studied all available books and pamphlets on sex education and the general field of social hygiene. After a plan had been outlined, conferences were held with the principal and dean of girls. The approval and cooperation of the school administration was considered essential. Following the periods of preparation, planning and approval the plan was set in operation without *any* publicity.

The biology course was revised to include reproduction in its place with the other fundamental life processes. Care was taken to give no more emphasis to reproduction than to digestion, respiration or any of the other life processes.

Because first impressions have so much influence on later attitudes toward sex, careful attention was given to the introduction of each new term or concept. For example: sexual and asexual were discussed as the two types of reproduction with examples from a wide range of plants and animals. Male and female were first used in connection with a study of algae. Sperm, egg and fertilization were introduced in the study of mosses. The first embryo discussed was a seed. Testes and oviducts were first seen in the frog.

A series of chick embryos was used. Discussions including student questions included the following topics: embryo food supply, twins, birth marks and abnormalities. For the study of heredity, examples were used from plants, animals and humans. A brief study of eugenics was introduced by having each student make a family chart on which they noted some characteristics in their families. Charts of famous and infamous families were shown and discussed.

When the subject of reproduction had been completed, a letter was sent to the parents of biology students. The letters were sent out from the high school office and were signed by the dean of girls and principal as well as the author. The following points were included in the letters: value of scientific information about sex and human reproduction; this knowledge should be given at home with the

guidance and knowledge of the parents; a foundation has been laid in the biology course and perhaps this is the time for that further instruction; this is a very difficult subject for parents who have not had the opportunity for special training; the school has a supply of pamphlets for parents, boys and girls, and these pamphlets will be sent free to parents who request them on the enclosed post-card form. The pamphlets will not be distributed at school. Suggestions and conferences with parents were invited.

Pamphlets used to fill the requests have been changed as new ones have become available. Advice from the staff of the American Social Hygiene Association has been helpful in selecting pamphlets. The ones now in use are:

For Parents—*The Parents' Part and When and How to Tell the Children.* Both from the Illinois Department of Public Health.

For Boys—*The Wonderful Story of Life* (boys) and *Keeping Fit.* Both from the Illinois Department of Public Health. *In Training.* From the American Medical Society.

For Girls—*The Wonderful Story of Life* (girls) and *Healthy, Happy Womanhood.* Both from Illinois Department of Public Health. *How Life Goes On and On.* From the American Medical Society.

A form letter was enclosed with the pamphlet sets suggesting that the parents keep them as long as they cared to, but that when they were through with them they should be returned. Approximately one-fourth have been returned. The cost of the project is not great. It is considered as an item in supplies.

During seven years the requests from parents for pamphlets has varied from 18% to 55%, with an average of about 40%. In over 60% of the cases parents requested pamphlets for both boys and girls. This results in a much greater coverage than would be indicated by the 40% requests.

Reactions have been entirely favorable. Expressions of appreciation have been oral, written, public and personal. One mother expressed her appreciation, and in explaining why she had not returned the pamphlets said that since she had received them, the pamphlets had been used in the homes of ten different friends and neighbors.

Community interest has expressed itself in the formation of an active social hygiene committee, of which the author was elected chairman.

The Illinois State Department of Public Health has purchased 150 copies of this plan for distribution to other schools. A number of other schools in the state have made modifications to meet local conditions and are using a similar procedure.

Exchange Service

I wish to exchange my lessons in taxidermy for specimens. The plan being: I will send the first lesson to a teacher or student. When the lesson has been mastered I am to receive a prepared skin, and so on until the course is finished. I have been teaching taxidermy in a club here for eleven years and the lessons are the outgrowth of this work.

E. E. Devereaux,
Central High School,
Lansing, Michigan

Biological Briefs

RUTH SHERMAN

LEWIS, HARRISON F. *Reverse Migration.* The Auk 56: 13–27. January, 1939.

Birds have been observed migrating in a direction opposite to the one usual for that season. In most cases of this sort, they are heading directly into the wind. Perhaps some birds habitually migrate against the direction of the wind, even when this necessitates a radical change in direction. Such occurrences need to be studied further. The author suggests the establishment of a series of observation stations at suitable points along favored routes of migration.

BENNETT, LOGAN J., AND GEORGE O. HENDRICKSON. *Adaptability of Birds to Changed Environment.* The Auk 56: 32–37. January, 1939.

A study of bird populations in Iowa marsh-lands has been made, comparing environmental and population changes which have occurred between the years 1907 and 1937. Much of the marsh-land has been partly or completely drained, thus diminishing the available food sources and nesting sites of marsh birds, and in their place substituting areas devoted to grains and bluegrass. While the total number of birds has been somewhat reduced, all the breeding species noted in 1907 were still present in 1937, and in addition 18 hitherto unrecorded species. Several land-nesting species are using bluegrass, oats, and alfalfa instead of native grasses for materials. It may therefore be possible that economic and conservational interests can be in accord, and that animal species can make adaptations to man-made changes in environment without the special intervention of conservational agencies.

RAMALEY, FRANCIS. *Sand-Hill Vegetation of Northeastern Colorado.* Ecological Monographs 9(1): 1–51. January, 1939.

This is a thorough ecological study of the flora occurring in a type of environment not so frequently studied. Topics include climatology, soils, physiographic plant ecology, plant communities, succession, local and seasonal societies, the seasonal march of vegetation, and discussion of communities. In regions where similar communities occur, this would appear to be of considerable value in biologic teaching.

BABCOCK, H. L. *How to Find a Bee-Tree.* DOW, RICHARD, AND R. J. HAMMERSTROM. *Honeybee Facts.* New England Naturalist 1: 2–3, 5–8. December, 1938.

This is the first issue of a journal published by the New England Museum of Natural History, and one which promises to be a valuable teaching aid. Articles are well written and illustrated, so that they may be used by student as well as teacher. The wild honeybees of New England are descendants of colonies of European honeybees imported in early colonial times. A bee-tree may be located

by trapping a worker, allowing her to gather a load of honey-water from the trap, and then following her successive flights to the colony. Nests are often in old partly decayed and hollow trees, well up on the trunk or in one of the higher branches.

The second article presents a summary of the life history, habits, and care of the honeybee, well illustrated.

LONG, CHARLES I. *Insect Galls.* Scientific Monthly 48(2): 152–158. February, 1939.

Gall-forming insects include gall-wasps, gall-gnats, and aphids, and less commonly sawflies, thrips, caterpillars, and chalcis flies. Usually the gall forms around the feeding larva, and the adult emerges by sawing its way out with its jaws. The galls of aphids, which have sucking mouthparts, possess natural holes through which the adults emerge. Some gnat pupae have spines with which to bore an exit tunnel; in other galls, a rupture of the wall coincides with the emergence of the adult. In most cases, galls form as the result of irritating poisons secreted at the time of oviposition; where galls form only after the larvae have begun feeding, the movements and secretions of the latter are probably the activating agents. The correlation between insect structure and habit and gall form might be explained by natural selection. Parthenogenesis, and alternation of sexual with parthenogenetic forms, are common among gall-wasps and aphids. Trees commonly afflicted with galls include oaks, hickories, and willows; other plants include goldenrod, loose-strife, and members of the rose family.

LEATHERS, W. S., AND A. E. KELLER. *An Investigation Concerning the Status of Hookworm in Florida.* American Journal of Hygiene 29(1) Section D: 1–16. January, 1939.

In a study of inhabitants of rural communities in Florida in 1937–1938, 29,064 whites were examined. Of these, 34.8% gave a positive test, with western sections testing highest in frequency and southern counties testing lowest. The greatest incidence occurred in school children, especially in those 15 to 19 years old. There was a positive correlation between the number of infested members of one family and the degree of infestation. The prevalence of hookworm in negroes was approximately half that of the whites in the same area, while the severity of infection in negroes was only one third as great.

REQUEST FOR COURSES OF STUDY

Ross Clover of San Juan Union High School, Fair Oaks, California, would like to receive unit or lesson outlines for year courses in biology from teachers throughout the United States. It is desired that the topic sequence for the entire school year be given, together with the reasons why such an order is followed. Information on the location and size of the school and on community industries would be very helpful. A survey of such material would give some idea of the relative popularity of biology courses presented through the "types," "principles," and "systematic" approaches. The data received will be summarized in the AMERICAN BIOLOGY TEACHER.

Biology as an Upper Grade Subject

LOWELL C. FROST
Beverly Hills High School

Does a tenth grade student learn all that he should know about biology? It would seem that the answer generally accepted as true is Yes; for in most high schools biology is accepted as a tenth grade subject, and no provision is made for any further acquisition of biological knowledge.

In examining any of the more widely-used textbooks one will find an attempted summary of almost every conceivable biological topic. Concrete and abstract, practical and theoretical, all are lumped together and thrown at the head of the tenth grade youngster. The author apparently hopes that the teacher will in some miraculous way be able to make the alternation of generations, the application of hereditary principles, and the relation of environment to heredity, comprehensible to a tenth year mind. This attitude of the author is perhaps excusable because forced on him by the publisher who feels that his text must contain all of the biological material that any other publisher's text contains—and a bit more.

There is a marked differentiation between the mind of the lower-grade student and that of the upper-grade student. It is conceded, of course, that there is no sharp dividing line at the end of the tenth year, and also that some individual students accomplish this differentiation at varying ages. But the fact remains that most tenth grade students are interested in *concrete* things and that they think in these terms. It is only in the eleventh and twelfth grades that most students begin to generalize and to think in the broader terms of the abstract. The practical comes before the theoretical, the concrete before the abstract, particulars before generalizations. In the tenth year a cow is a particular creature that gives milk. To talk of a cow as a mammal which developed certain characteristics because of the influence of environment and heredity, to discuss why these two factors worked as they did, and to inquire about the relationship of the cow to the human race physically and economically —all this, while important, is like laying a steak before a three-year-old child equipped with a spoon.

There is enough concrete material in the living world to interest a tenth grade biology class for many times forty weeks —and all of it vitally important. Why attempt the impossible by feeding them food which they cannot yet assimilate?

But if we take away from tenth grade biology the generalizations, relationships, theories, hypotheses, and evolutionary developments, are we not losing most of the values of high school biology, which should come to a focus in the relationships of the living world to man? The answer is NO. But it indicates that there should be an advanced high school biological course in which this type of material should be considered.

A few years ago biology was a comparatively small body of knowledge, and it was largely in the concrete descriptive stage. Genetics and all which that implies, evolutionary theories, paleontology, and anthropology, have been added to that meager store of knowledge. And no high school graduate can afford to be without a knowledge of euthenics and

(Continued on page 161)

A Plan for Biology Textbook Reviews

We have purposely excluded textbook reviews from The American Biology Teacher until we could develop a plan that gave promise of producing evaluations worthy of consideration. We have developed an approach to this problem of evaluation that is different from the traditional one. Whether it is more valuable remains to be seen. Suggestions for revising our present method of obtaining reviews and general criticisms of it are always welcome. With your cooperation we are ready to introduce the plan outlined herewith.

Each textbook review will consist of five sections contributed by five separate reviewers working independently. Each section of the review will deal with one of the following aspects of the book:

1.—Mechanical Make-up and Cost.
2.—Pedagogical Soundness.
3.—Subject Matter.
4.—Literary Style.
5.—Learning Exercises and Teacher Helps.

Our present task is to establish a committee of reviewers. We urge all secondary school teachers of biology who are interested in taking part in this work to send their names to the chairman of this committee with a brief statement of the elements of textbook evaluation to which they would like to be assigned. Arrangements have been completed with many publishers to provide an adequate supply of copies of the texts under consideration for the reviewers.

We appreciate that this work is of general interest and we hope that many of our qualified readers will avail themselves of this opportunity to render a valuable service to biology teaching. The committee on textbook reviews should be large so that points of view expressed be representative of the country as a whole. We should start with a committee of at least a hundred names. We urge that all interested members communicate without delay with the chairman of the textbook reviewing committee:

ALAN A. NATHANS,
Christopher Columbus High School, Astor and Waring Avenues, Bronx, N. Y. C.

A NEW CHAPTER

The first meeting of the Southern California Association of Biology Teachers, a chapter of the National Association of Biology Teachers, was held January the ninth at the John H. Francis High School in Los Angeles.

The officers elected were Miss Edith A. Kraeft, President; Mr. George F. Hottfrerich, Vice-President; Mr. Robert P. Hays, Treasurer; Mrs. Karyn B. Sanders, Recording Secretary; and Mrs. Doris C. Siddall, Corresponding Secretary.

DORIS C. SIDDALL,
Corresponding Secretary

(Continued from page 160)

eugenics, Mendelian laws and their application, allergy and immunity, paleontology and migrations, mutation and the gene theory, adaptation and environment —to mention only a few topics. But these topics can be adequately taught only to those students whose minds have developed the capacity to think in broad terms. They should, with others of a similar nature, form the core of an *upper-grade* course in biology.

MILLER, D. F., AND BLAYDES, G. W. *Methods and Materials Teaching Biological Sciences.* New York: McGraw Hill, 1928. 435 pp. $3.50.

This textbook and source book for teachers in training and teachers in service contains a wealth of useful material. It is divided into two parts. Part one is primarily a course in biological methods for teachers in service. The text proper is supplemented by a number of problems in which the principles discussed can be worked out in practical fashion. The bibliography and the extensive index add to the usefulness of the book.

The authors apparently feel that many high-school courses in biology follow a textbook in a blind and slavish way and that the class period is too often nothing but a repetition of the statements in the textbook assignment for the day. If that is the state of affairs teachers in service may well pay heed to the oft-reiterated emphasis on the study of living things.

Definite criteria for judging textbooks are listed. The authors favor breaking away from strict adherence to any one text and suggest placing at the disposal of the pupils a number of books to be used as references. The chapter on the evaluation program included a discussion of various types of tests and examinations with special emphasis on the newer kinds of tests and measurements.

One of the most stimulating chapters is the one entitled, "The Lack of Materials and Equipment." It is refreshing to find in place of the elaborate and expensive array of equipment no laboratory should be without a frank recognition of the financial limitations of the average biology department. The authors proceed to suggest and describe inexpensive and easily procurable substitutes that may serve the purpose about as well as the apparatus especially made for biological laboratories. They think that much of the material used, both plant and animal, should preferably be collected by teacher or pupils.

Part two is a source book on the collection, preparation, and use of material for the classroom. It is this part of the book which will probably prove of greatest interest and value to the experienced teacher, for in it is included almost every plant or animal that would ever be used in biology classes. It takes in many forms seldom if ever used in elementary work as well as the more familiar ones. Technical specific names are generally used, and brief notes and descriptions of habitat, appearance, and methods of preservation are given for each form. A number of drawings are included.

One chapter is devoted to the preparation of microscopic material. Methods described are, in general, simple ones not involving the use of a microtome. A number of formulas for stains and reagents are listed.

Under the head of physiological processes such as photosynthesis, digestion and the like we find a number of practical and interesting experiments and demonstrations that do not require much expense or elaborate apparatus. Some of them are doubtless familiar to most biology teachers but others new to most of us. Some of the suggestions might perhaps be more appropriate for classes at the college or junior college level than for high-school pupils. Demonstrations which call for pithing a frog, sawing the shell of an etherized turtle and dissecting the turtle to show the beating of the heart may not be a wise thing for all secondary school groups.

Here is a source book, however, which contains so much useful information, so many definite and practical suggestions that it is destined not merely to be read with interest but to be thumbed over and over by any biology teacher fortunate enough to have a copy available.

HELEN J. MANK

DOBELL, C. *Anthony Leeuwenhoek and His "Little Animals."* Harcourt, Brace. 1932.

Most biology teachers have probably heard of Dobell's treatise on Leeuwenhoek, published in 1932 on the three hundredth anniversary of the Dutch microscopist's birth. This belated review is prompted by two factors. First, while the volume was published at a price of seven dollars and a half, it has recently been offered, as a publisher's remainder, at two dollars and a half. At this price it should certainly be in every high school library, and every teacher's, if the supply is sufficient.

Second, this review may be made the occasion for reference to the persistent fallacies regarding Leeuwenhoek which seem to be widely instilled in the field of high school biology. They come to my attention both in the form of elementary texts, and in the fixed ideas of many first term students in college biology. College texts in biology, botany, and zoology seem to be free of erroneous Leeuwenhoek data, as indicated by an examination of thirty-odd texts.

As Dobell writes, his interest as a bacteriologist and protozoologist was aroused when on different occasions he found that Leeuwenhoek had been the first to see and report the existence of bacteria, free-living protozoa, and parasitic protozoa. For twenty years he pursued the study of Leeuwenhoek's contributions in these fields, mastering 16th century Dutch as part of the procedure. Now known as Leeuwenhoek's "greatest living admirer," Dobell does not find it necessary to claim that he invented the instrument. He expressly notes that all Leeuwenhoek's microscopes were simple lenses, which had had a long earlier history and use, to Roger Bacon in the 13th century, if not even to classical times. Dobell does not ask either that Leeuwenhoek be recognized as the first to use magnification for the examination of living things. He notes that Malpighi, Hooke, Borell, and others of his contemporaries had preceded him by ten or fifteen years in using some form of magnification in the study of living things. Leeuwenhoek, himself, in one of his letters (1675), mentions Swammerdam as describing certain minute animals of stagnant water. Furthermore, as Dobell notes, the Italian, Stelluti, had figured insect anatomy before Leeuwenhoek was born, and Singer is authority that Galileo had noted the compound eyes of insects by 1610, and is to be counted "the effective inventor of the compound microscope."

Not to continue citations of what Leeuwenhoek had not discovered, the things for which credit is due may be cited. Dobell calls him the father of both bacteriology and protozoology. Following his announcements of these microorganisms, their possible connection with infections was immediately suggested. By nearly all accounts, Leeuwenhoek was a careful observer, who made mistakes, but did not hesitate to correct them later, and who clearly differentiated between his observations and his speculations. His observations had much to do also with interesting men of the day in what we call microbiology. His contemporaries, Malpighi, Grew, and Swammer-

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dam, were the founders of the micro-anatomy of plants and animals.

RALPH C. BENEDICT,
Brooklyn College

FASTEN, NATHAN. *Principles of Genetics and Eugenics.* New York: Ginn and Company. 1936. 391 pp.

This text was prepared by Nathan Fasten, Ph.D., Professor and Head of the Department of Zoology of Oregon State College, for the elementary student in Genetics and Eugenics, who desires brief and accurate information in these studies. It is not necessary to have had an elaborate course in Biology to understand the principles of this book.

Throughout the treatise emphasis is placed on good heredity and good environment as the fundamental bases for the finest development of any living organism. Heredity alone is not responsible for the problems of society—environment is of great importance. Five billion dollars annually is too much to pay for those who falter in the ranks because of imperfections in heredity and environment. This ever increasing debt can only be lessened through proper education of the public in the working principles of Genetics and Eugenics. The author estimates that there are some eighteen million defectives in the United States. His hope is to increase the normal and gifted, and at the same time decrease the abnormal and deficient population.

Special attention has been devoted to the scope of eugenics, the Mendelian principles of Heredity, Variation, Environment and Applied Eugenics in relation

to the betterment of human society. Dr. Fasten treats his subject matter briefly in a rare and brilliant manner, using some 140 diagrams and photographs to simplify his deductions. No unnecessary technicalities are presented, thus giving the book a very readable style for the average elementary student.

STEPHEN W. ROBERTS

PALMER, RICHARD. *Living Things an Introduction to Biology.* London, England: George Allen & Unwin Ltd., Museum Street. 1937. 400 pp.

"Living Things" is a type of book a professional man likes to keep in his library, not as another reference or textbook (it is both of these) but merely to browse through for a new idea, a different approach or for casual reading. It was written to meet the requirements of "certain examination syllabuses including the Matriculation Examinations of the English Universities and the Central Welsh Board." Due to its Continental makeup I would not consider it as a competitor of American biology textbooks at the Secondary level.

Its approach is acceptable. Starting with man the known it proceeds to the theoretical and the speculative aspects of biology. The first of the two main divisions is titled "How Living Things Work." Dealing with stereotyped material ordinarily contained in textbooks, however, the treatment is interestingly different. Part two deals with "The Diversity of Living Things" in which Dr. Palmer explains the groups of plants and animals. In this connection an interesting sidelight is revealed in the appendix—Outline Classification of Living Things. This contains four kingdoms of living things—the Filter Passing Viruses, Bacteria, Plants, and Animals. Certain contemporary American authorities would not agree with the first or even the second classification division. This new view makes the book distinctive and is

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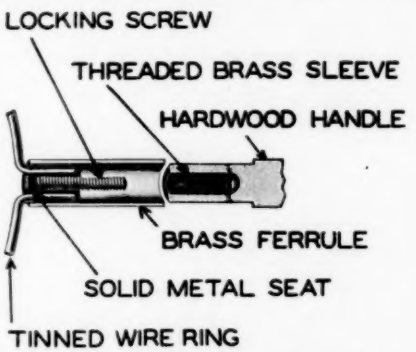

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apparent also in a number of other instances throughout.

If a biological principle can be best illustrated by physical or chemical approaches he employs this means. This practice is an inherent weakness among American authors. For example, an entire page is devoted to the mechanics of blood pressure in the various aspects illustrated by physical laws; explaining there is great pressure in the arteries and slight in the veins; together with reasons. An American author would explain that the blood is foreed through the arteries by eardiac action, returned through the veins by a sympathetic action of the vein by the artery and by muscular action and let it go at that. The chemistry of foods is another good example; there is more detail in the chemistry of food than is found in a modern chemistry text for secondary schools. My personal opinion is that texts of the future are going to trend more toward this "unification of the sciences treatment."

Only an English author would open the discussion of cells with the speculative statement, "Your body contains, it is said, about one thousand billion cells." Illustrations, of course, are apropos to the region; there are used "humble bee," "water weed" for aquatic plant and others. Certain topics receive more treatment, as "cranial nerve," "oogenesis," "blind spot" and others. The strong point in my estimation is its generous sprinkling of psychological experiments and the psychological point of view which unfortunately are avoided or intentionally neglected in most American texts.

The mechanics of the book are inferior, the binding poor and paper low grade. However, the delivery price to me last summer after a seven weeks' wait for my order was nominal, less than two dollars.

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There are no halftones but the line drawings are good. Educationally the book is below par compared with American texts. It is built on a chapter basis, which is not a criticism at points, but the amount of enrichment material we feel essential is lacking. It is truly an experimental treatment; by that I mean there are many experiments at frequent intervals throughout the work. These experiments are interesting in that they are used to prove a point in a different light that we are accustomed to.

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